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APPLICANTS:	Peter B. Evans and Steven E. Schumer
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APPEAL BRIEF

Real Party in Interest

The subject application is owned by Peter B. Evans of Los Altos Hills, California, and Steven E. Schumer of San Jose, California.

Related Appeals and Interferences

There are no known related appeals or interferences that may directly affect, be directly affected by, or have a bearing on the Board's decision in the pending appeal.

Status of Claims

Claims 1-14 and 19-20 stand finally rejected. Claims 15-18 are withdrawn. On September 22, 2008, the final rejection of claims 1-14 and 19-20 was appealed. The claims on appeal are set forth in an appendix attached hereto.

Status of Amendments

Appellant has not amended the claims since the final rejection.

Summary of Claimed Subject Matter

The independent claims on appeal are claims 1, 2, 10 and 19. Claim 1 recites a method for simulating an electric power network having a plurality of transmission-level buses and connected electrical elements and a plurality of distribution-level buses and connected electrical elements (see e.g., spec. page 27, ¶ [00110]; FIG. 2). Initially, a model of the transmission-level buses and connected electrical elements which includes a plurality of transmission lines and a plurality of transmission electrical elements is determined (see e.g., spec. page 26, ¶ [00108]; page 27, ¶ [00111]; in FIG. 2, element 204). Similarly, a model of the distribution-level buses and connected electrical elements which includes a plurality of distribution lines and a plurality of distribution electrical elements is determined (see e.g., spec. page 26, ¶ [00108]; page 28, ¶¶ [00112]-[00114]; in FIG. 2, elements 2010, 2012). A single mathematical model is generated by

integrating the model of the transmission-level buses and the model of the distribution-level buses are integrated. The single mathematical model also models the interdependency of the plurality of transmission lines and the plurality of transmission electrical elements in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements in the model of the distribution-level buses (see e.g., spec. page 21, [0087]; page 26, ¶ [00108]; page 29, ¶¶ [00116]-[00117]; page 30, ¶ [00119]; in FIG. 2, elements 2014, 2016). Operation of the electric power network is simulated using the single mathematical model and data describing the simulated electric power network is output (see e.g., spec. page 31, ¶¶ [00121]-[00124]; in FIG. 2, element 2020; in FIG. 2, block 302).

Claim 2 recites a method for analyzing an electric power network having a plurality of transmission-level buses and connected electrical elements and a plurality of distribution-level buses and connected electrical elements (see e.g., spec. page 27, ¶ [00110]; FIG. 2). A model of the transmission-level buses and connected electrical elements including a plurality of transmission lines and a plurality of transmission electrical elements is determined (see e.g., spec. page 26, ¶ [00108]; page 27, ¶ [00111]; in FIG. 2, element 204). Additionally, a model of the distribution-level buses and connected electrical elements including a plurality of distribution lines and a plurality of distribution electrical elements is determined (see e.g., spec. page 26, ¶ [00108]; page 28, ¶¶ [00112]-[00114]; in FIG. 2, elements 2010, 2012). The model of the transmission-level buses and the model of the distribution-level buses are integrated to generate a single mathematical model that also models the interdependency of the plurality of transmission lines and the plurality of transmission electrical elements in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements in the model of the distribution-level buses (see e.g., spec. page 21, [0087]; page 26, ¶ [00108];

page 29, ¶¶ [00116]-[00117]; page 30, ¶ [00119]; in FIG. 2, elements 2014, 2016). The single mathematical model is used to assess the simulated electric power network by characterizing power flow, losses, voltage profile and power factor. Data describing the condition or the performance of the simulated electric power network is subsequently output (see e.g., spec. page 31, ¶¶ [00121]-[00124]; in FIG. 2, element 2020; in FIG. 2, block 302).

Claim 10 recites a method for analyzing performance of a modeled electric power network having a plurality of transmission-level buses and connected electrical elements and a plurality of distribution-level buses and connected electrical elements (see e.g., spec. page 27, ¶ [00110]; FIG. 2). A model of the transmission-level buses and connected electrical elements including a plurality of transmission lines and a plurality of transmission electrical elements is determined (see e.g., spec. page 26, ¶ [00108]; page 27, ¶ [00111]; in FIG. 2, element 204). Also, a model of the distribution-level buses and connected electrical elements including a plurality of distribution lines and a plurality of distribution electrical elements is determined (see e.g., spec. page 26, ¶ [00108]; page 28, ¶¶ [00112]-[00114]; in FIG. 2, elements 2010, 2012). A single mathematical model is generated by integrating the model of the transmission-level buses and the model of the distribution-level buses. The single mathematical model also models the interdependency between the plurality of transmission lines and the plurality of transmission electrical elements included in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements included in the model of the distribution-level buses (see e.g., spec. page 21, [0087]; page 26, ¶ [00108]; page 29, ¶¶ [00116]-[00117]; page 30, ¶ [00119]; in FIG. 2, elements 2014, 2016). The modeled electric power network is assessed by characterizing power flow, losses, voltage profile and power factor (see e.g., spec. page 31, ¶¶ [00121]-[00124]; in FIG. 2, element 2020; in FIG. 2, block 302).

Incremental real and reactive energy sources are added to locations of the modeled electric power network and load-flow analysis is used to assess the condition and performance of the simulated electric power network with the added incremental real and reactive energy sources to determine whether the performance of the modeled electric power network is improved as a result of the added real and reactive energy sources (see e.g., spec. page 34, ¶ [00136], [00137]; page 36, ¶ [00145]; page 33, ¶¶ [00130]-[00135] in FIG. 3; elements 306, 308, 3014). A set of added real and reactive energy sources that yields a greatest improvement in network performance is determined and characterized as specific distributed energy resources which are described via output (see e.g., spec. page 35 ¶ [00142]; in FIG. 3, element 3016).

Claim 19 recites a computer readable medium comprising a computer program that when executed in a computer processor implements a series of steps. As the steps are executed, a model of the transmission-level buses and connected electrical elements including a plurality of transmission lines and a plurality of transmission electrical elements is determined (see e.g., spec. page 26, ¶ [00108]; page 27, ¶ [00111]; in FIG. 2, element 204). Also, a model of the distribution-level buses and connected electrical elements including a plurality of distribution lines and a plurality of distribution electrical elements is determined (see e.g., spec. page 26, ¶ [00108]; page 28, ¶¶ [00112]-[00114]; in FIG. 2, elements 2010, 2012). A single mathematical model is generated by integrating the model of the transmission-level buses with the model of the distribution-level buses. The single mathematical model also includes the interdependency of the plurality of transmission lines and the plurality of transmission electrical elements included in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements included in the model of the distribution-level buses (see e.g., spec. page 21, [0087]; page 26, ¶ [00108]; page 29, ¶¶ [00116]-[00117]; page 30,

¶ [00119]; in FIG. 2, elements 2014, 2016). Hence, the single mathematical model integrates models of the distribution-level buses and connected electrical elements are integrated with models of the transmission-level buses and connected electrical elements (see e.g., spec. page 21, [0087]; page 26, ¶ [00108]; page 29, ¶¶ [00116]-[00117]; page 30, ¶ [00119]; in FIG. 2, elements 2014, 2016). Operation of the electric power network is simulated with the single mathematical model and a condition or a performance of the simulated electric power network is calculated and described via output data (see e.g., spec. page 31, ¶¶ [00121]-[00124]; in FIG. 2, element 2020; in FIG. 3, block 302).

Grounds of Rejection to be Reviewed on Appeal

Whether claims 1-14 and 19-20 are anticipated under 35 U.S.C. § 102(a) by "Operations Review of June 14, 2000 PG&E Bay Area System Events Using Aempfast Software" (hereinafter "Optimal Technologies").

Argument

Claims 1-14 and 19-20 Are Not Anticipated by Optimal Technologies

To anticipate a claim, a reference must teach each and every element of the claim. *Verdegaal Bros. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631, 2 U.S.P.Q.2d (BNA) 1051, 1053 (Fed. Cir. 1987) ("A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference."); *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 U.S.P.Q.2d (BNA) 1913, 1920 (Fed. Cir. 1989) ("The identical invention must be shown in as complete detail as is contained in the . . . claim"); *see also* MPEP § 2131. Moreover, a reference does not anticipate a claim unless the elements in the

reference are arranged as required by the claim. *In re Bond*, 910 F.2d 831, 15 U.S.P.Q.2d (BNA) 1566 (Fed. Cir. 1990).

Claims 1, 2, 10 and 19 variously recite "generating a single mathematical model <u>by integrating the model of the transmission-level buses with the model of the distribution-level buses</u>, wherein the single mathematical model further models the interdependency of the plurality of transmission lines and the plurality of transmission electrical elements included in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements included in the model of the distribution-level buses" (emphasis added). Optimal Technologies clearly does not disclose at least these aspects of the claimed invention.

These aspects of the claimed invention promote comprehensive assessment of the effects of an electric power network by integrating distribution elements with transmission elements in a single mathematical model which also accounts for the interdependency between a plurality of transmission lines, a plurality of transmission electrical elements, a plurality of distribution lines and a plurality of distribution electrical elements. These aspects of the claimed invention permit greater detail in electric power network analysis by direct inclusion of interdependencies between transmission-level effects from transmission lines and transmission electrical elements and distribution-level effects from distribution lines and distribution electrical elements using an integrated model of transmission-level buses and distribution-level buses, improving the accuracy of the evaluation. Conventionally, separate models are used to simulate distribution and transmission, preventing inclusion of relationships between transmission elements and distribution elements in power network analysis.

Optimal Technologies does not disclose generating the model used to analyze the power network, much less integrating a model of the transmission-level buses with a model of the distribution-level buses. Rather, Optimal Technologies merely discloses reformatting a received data file, partitioning the data file (i.e., reducing the scope and size of the data set) to identify a subset for analysis and analyzing the partitioned subset using conventional load flow analysis (page 15, §4.1.1, ¶ 2-6; page 18, § 5.1, ¶1; §5.1.2). Hence, Optimal Technologies merely reformats and partitions a received description of a power network and does not disclose "integrating the model of the transmission-level buses with the model of the distribution-level buses" to generate a "single mathematical model," as claimed. Rather, Optimal Technologies simulates the power network described by the data file using load flow analysis.

In describing analysis of an example electric power network, Optimal Technologies discloses reformatting a received Cal ISO data file and partitioning the reformatted data file to identify a subset of data for analysis using conventional load flow analysis (page 18, §§ 5.1-5.1.2; page 19, §§6.1-6.1.2; page 19, table 3). Reformatting merely converts the data file from a first format to a second format (in the example provided, the data file is converted from a GE PSLF EPC data file format to a CWF file format). Similarly, partitioning merely identifies a subset of the data file for further analysis (in the example provided, the PG&E subsystem is extracted from the WECC system described by the data file) (pages 16-17, § 4.2.2, 4.2.2.2). Table 4 in Optimal Technologies shows that, after reformatting and partitioning, no distribution electrical elements are added to the original data file, as required to generate a single mathematical model which integrates both transmission and distribution models of the power network (page 20, § 6.2; Table 4). Optimal Technologies does not add any elements to the initially received data file, but at most identifies a subset of the data file for detailed analysis.

Hence, in Optimal Technologies, the content of the externally received data file specifies how a power network is analyzed. In contrast, the claimed invention integrates "the model of the transmission-level buses with the model of the distribution-level buses," to generate a "single mathematical model" for electric power network simulation. Optimal Technologies does not integrate disparate models to generate the power network model used for analysis, but merely uses the content of the received data file for power network modeling. The claimed invention directly includes interdependencies between transmission-level effects from transmission lines and transmission electrical elements and distribution-level effects from distribution lines and distribution electrical elements to improve power network simulation accuracy. In contrast, Optimal Technologies at most performs conventional analysis on a power network described by a data file. Nowhere does Optimal Technologies disclose the content of the data file, but merely provides that the data file is used in network analysis. Nor does Optimal Technologies disclose or suggest how the data file characterizes the power network being analyzed, giving no indication that the data file departs from conventional power network modeling techniques of separately modeling distribution networks and transmission networks. At most, Optimal Technologies can be interpreted to disclose the capability of using a data file to model a power network and that use of this data file allows Aempfast to rank and index "every bus on a system according to system resource need" and to rank and index "all generators according to their ability to support and carry load and to help prevent voltage collapse" (page 13, § 3, ¶¶2-5). However, this merely describes potential benefits resulting from analysis of the received data file and provides no disclosure of the content of the data file used for analysis or of the prepration of the the data file used for analysis. While the claims explicitly recite generation of a specific type of "single mathematical model" used to analyze a power network, Optimal Technologies merely

discloses a broad capability of using a data set to analyze a power network without providing details regarding what is included in the data file or how the data file models a power network.

The claims explicitly recite generating a "single mathematical model by integrating the model of the transmission-level buses with the model of the distribution-level buses, wherein the single mathematical model further models the interdependency of the plurality of transmission lines and the plurality of transmission electrical elements included in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements included in the model of the distribution-level buses." The mere use of a data file to analyze a power network cannot be construed as anticipating this claimed element. *See* Advisory Action dated August 11, 2008. Optimal Technologies only discloses receiving a data file and using the received data file to analyze an electric power network. The content or preparation of this data file is never disclosed or even suggested in Optimal Technologies. As the claims explicitly provide that disparate models of transmission-level buses and distribution-level buses as well as the interdependency between transmission-level elements and distribution-level elements are included in the single mathematical model, the broad, general disclosure of a data file describing a power network in Optimal Technologies is insufficient to disclose each and every claim element as required to sustain a rejection under 35 U.S.C. §102(a)..

To justify the Examiner's interpretation of Optimal Technologies, the Examiner cites additional references in the Final Office Action. However, these additional references fail to provide any additional context for Optimal Technologies and merely restate portions of Optimal Technologies. Hence, even in view of these additional references, Optimal Technologies fails to disclose "generating a single mathematical model by integrating the model of the transmission-level buses with the model of the distribution-level buses, wherein the single mathematical

model further models the interdependency of the plurality of transmission lines and the plurality of transmission electrical elements included in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements included in the model of the distribution-level buses," as claimed. At most, these additional references merely list possible benefits or features of the Aempfast software described in Optimal Technologies. Nothing in these additional references discloses or suggests construing any portion of Optimal Technologies as disclosing generating a single mathematical model by integrating the model of the transmission-level buses with the model of the distribution-level buses to simulate a power network.

The Teresko article referenced by the Examiner merely indicates that Aempfast is able to view various network component contributions in real-time. However, real-time component monitoring does not disclose or suggest that Aempfast integrates "the model of the transmission-level buses with the model of the distribution-level buses" to generate "a single mathematical model," but provides that Aempfast may rapidly process received data. The speed at which Aempfast is capable of processing data provides no insight into how the data file in Aempfast characterizes the power network being analyzed. Alluding to Aempfast's data analysis speed does not disclose or suggest that Aempfast generates "a single mathematical model by integrating the model of the transmission-level buses with the model of the distribution-level buses," as claimed.

Similarly, the BusinessWire article referenced by the Examiner lists potential types of data analysis that Aempfast may perform. However, the mere listing of possible benefits of analyzing power network data with Aempfast, such as "real-time emergency response analysis" and "advanced emergency response and contingency planning for local, regional and national

power grids" does not provide any indication of how Aempfast provides these benefits using a specific type of power network modeling. Contrary to the Examiner's assertions in the Advisory Action, these general statements about types of network analysis do not provide any insight into the model used by Aempfast for analysis, but only tout the potential results of Aempfast with no indication of how these results are achieved. *See* Advisory Action dated August 11, 2008. Merely listing potential benefits does not disclose or suggest that Aempfast generates a single mathematical model by integrating "the model of the transmission-level buses with the model of the distribution-level buses," as claimed.

Further, in the Advisory Action, the Examiner alleges that "Applicants have failed to provide evidence that the Aempfast software used in Optimal Technologies does not anticipate the claim limitations." *See* Advisory Action dated August 11, 2008. However, a claim is anticipated "only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631, 2 U.S.P.Q.2d (BNA) 1051, 1053 (Fed. Cir. 1987). The Examiner has provided only blanket statements that Optimal Technologies analyzes an electric power network and provides no evidence of the type of model used by Optimal Technologies to perform network analysis. To maintain a rejection under 35 U.S.C. § 102(a), the reference must show the identical invention in a level of detail commensurate with the detail of the claim. *Richardson v. Suzuki Motor Co.,* 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989) ("The identical invention must be shown in as complete detail as is contained in the...claim"). Optimal Technologies cannot be interpreted as disclosing the generation of a single mathematical model by "integrating the model of the transmission-level buses with the model of the distribution-level buses, wherein the single mathematical model further models the interdependency of the

plurality of transmission lines and the plurality of transmission electrical elements included in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements included in the model of the distribution-level buses," as there is only a broad, non-specific reference to modeling a power network, with no description of how the power network is modeled in Optimal Technologies. The Examiner has only provided evidence of the alleged benefits of the Aempfast software in Optimal Technologies and has assumed, from those benefits, how the Aempfast software works without providing any evidence from Optimal Technologies or any other source to support this assumption. None of the references cited by the Examiner provide any disclosure of the type of model used by Aempfast in network analysis, while the claimed invention recites a specific single mathematical model including transmission-level elements, distribution-level elements and the interdependencies between the transmission-level elements and the distribution-level elements.

The alleged benefits of Aempfast described by Optimal Technologies and referenced by the additional references do not provide insight into how Aempfast models a power network to provide the listed benefits or analysis speed. Therefore, Aempfast does not disclose "integrating the model of the transmission-level buses with the model of the distribution-level buses, wherein the single mathematical model further models the interdependency of the plurality of transmission lines and the plurality of transmission electrical elements included in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements included in the model of the distribution-level buses," as claimed. The only disclosure of how Aempfast analyzes a power network in Optimal Technologies, the Teresko article and the BusinessWire article are achieved by reformatting and partitioning a received data

file to identify a subset of data for analysis and performing load flow analysis on the subset of data, as disclosed by Optimal Technologies. (page 15, § 4.1.1, ¶¶ 2-6).

Thus, Optimal Technologies fails to disclose the claimed element of "integrating the model of the transmission-level buses with the model of the distribution-level buses, wherein the single mathematical model further models the interdependency of the plurality of transmission lines and the plurality of transmission electrical elements included in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements included in the model of the distribution-level buses." Hence, each of the pending rejections suffers from a clear deficiency so Applicants request withdrawal of the rejections of claims 1-14, 19 and 20.

Conclusion

For the foregoing reasons, the Examiner's rejection of claims 1-14 and 19-20 was erroneous, and reversal the Examiner's decision is respectfully requested.

Respectfully submitted,
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Appendix: Claims Involved in Appeal

1. A method for simulating an electric power network having a plurality of transmission-level buses and connected electrical elements and a plurality of distribution-level buses and connected electrical elements, the method comprising:

determining a model of the transmission-level buses and connected electrical elements, the model of the transmission-level buses including a plurality of transmission lines and a plurality of transmission electrical elements;

determining a model of the distribution-level buses and connected electrical elements, the model of the distribution-level buses including a plurality of distribution lines and a plurality of distribution electrical elements;

generating a single mathematical model by integrating the model of the transmission-level buses with the model of the distribution-level buses, wherein the single mathematical model further models the interdependency of the plurality of transmission lines and the plurality of transmission electrical elements included in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements included in the model of the distribution-level buses;

simulating an operation of the electric power network with the single mathematical model; and

outputting data describing the simulated electric power network.

2. A method for analyzing an electric power network having a plurality of transmission-level buses and connected electrical elements and a plurality of distribution-level buses and connected electrical elements, the method comprising:

determining a model of the transmission-level buses and connected electrical elements, the model of the transmission-level buses including a plurality of transmission lines and a plurality of transmission electrical elements;

determining a model of the distribution-level buses and connected electrical elements, the model of the distribution-level buses including a plurality of distribution lines and a plurality of distribution electrical elements;

generating a single mathematical model by integrating the model of the transmission-level buses with the model of the distribution-level buses, wherein the single mathematical model further models the interdependency of the plurality of transmission lines and the plurality of transmission electrical elements included in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements included in the model of the distribution-level buses;

assessing the simulated electric power network by characterizing power flow, losses, voltage profile and power factor; and

outputting data describing at least one of the condition and the performance of the simulated electric power network.

3. The method of claim 2, further comprising:

integrating models of theoretical distribution-level real and reactive energy sources connected to one or more of the plurality of distribution-level buses into the single mathematical model; and

observing impacts and effects across the simulated electric power network of the theoretical distribution-level real and reactive energy sources connected on one or more of the plurality of distribution-level buses.

4. The method of claim 2, further comprising:

integrating models of theoretical alternative topologies of the distribution-level portions of the electrical power network into the single mathematical model; and

observing impacts and effects across the simulated electrical power network of the alternative topologies of distribution-level portions of the network.

5. The method of claim 2, further comprising:

integrating additional models of theoretical distribution-level loads into the single mathematical model; and

observing impacts and effects of load growth across the simulated electrical power network due to the addition of theoretical distribution-level loads.

6. The method of claim 2, further comprising:

integrating models of theoretical transmission-level real and reactive energy sources connected to one or more of the plurality of transmission-level buses into the single mathematical model; and

observing impacts and effects across the simulated electric power network of the theoretical transmission-level real and reactive energy sources connected on one or more of the plurality of transmission-level buses.

7. The method of claim 2, further comprising:

integrating models of theoretical alternative topologies of the transmission-level portions of the electrical power network into the single mathematical model; and

observing impacts and effects across the simulated electrical power network of the alternative topologies of transmission-level portions of the network.

8. The method of claim 2, further comprising:

integrating additional models of theoretical transmission-level loads into the single mathematical model; and

observing impacts and effects of load growth across the simulated electrical power network due to the addition of theoretical transmission-level loads.

9. The method of claim 2, wherein the integrating models further comprises:

representing actual distribution-level buses and elements having an actual voltage and an actual topology with corresponding models of buses and elements characterized, at least in part, by representations of the actual voltages and the actual topologies of the distribution-level buses and elements.

10. A method for analyzing performance of a modeled electric power network having a plurality of transmission-level buses and connected electrical elements and a plurality of distribution-level buses and connected electrical elements, the method comprising:

determining a model of the transmission-level buses and connected electrical elements, the model of the transmission level buses including a plurality of transmission lines and a plurality of transmission electrical elements;

determining a model of the distribution-level buses and connected electrical elements, the model of the distribution level buses including a plurality of distribution lines and a plurality of distribution electrical elements;

generating a single mathematical model by integrating the model of the transmission-level buses with the model of the distribution-level buses, wherein the single mathematical model further models the interdependency of the plurality of transmission lines and the plurality of transmission electrical elements included in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements included in the model of the distribution-level buses;

assessing the modeled electric power network by characterizing power flow, losses, voltage profile and power factor;

adding incremental real and reactive energy sources in locations of the modeled electric power network;

assessing by load-flow analysis the condition and performance of the simulated electric power network with the added incremental real and reactive energy sources;

determining whether the performance of the modeled electric power network is improved as a result of the added real and reactive energy sources;

determining a set of added real and reactive energy sources that yields a greatest improvement in network performance;

characterizing the set of added real and reactive energy sources as specific distributed energy resources; and

outputting data describing the set of added real and reactive energy resources.

11. The method of claim 10, further comprising, quantifying an improvement in performance of the modeled electric power network due to the set of added real and reactive energy sources.

12. The method of claim 10, wherein adding incremental real and reactive energy sources further comprises:

representing the energy sources with models of the energy sources characterized, at least in part, by values of corresponding electric power network actual bus location and actual voltage level;

adding to the single mathematical model the models of the energy sources at one of the distribution-level buses and transmission-level buses, wherein the models of real energy sources are added subject to actual limits appropriate for dispatchable demand reductions available on the electric power network, and the real energy sources with reactive energy sources are added subject to actual limits appropriate for generation at load sites within the electric power network.

13. The method of claim 10, wherein determining whether the performance of the modeled electric network is improved as a result of the addition of energy sources comprises:

considering selected characteristics of a reduction of real power losses and reactive power losses, improvement in voltage profile, improvement in voltage stability, improvement of load-serving capability, and avoidance of additions of electric elements connected to the network that would otherwise be required.

14. The method of claim 10, wherein characterizing the additions of real and reactive energy sources comprises:

creating a plurality of mathematical models each having both distribution-level buses and connected electrical elements and transmission-level buses and connected electrical elements under a plurality of network operating conditions;

determining the additions of models of real and reactive energy sources that achieve the greatest improvement in network performance of the modeled network under each set of operating conditions;

characterizing each incremental addition of real or reactive energy sources as a discrete generation project, dispatchable demand response project, or capacitor bank project; and

comparing results achieved under each set of operating conditions to derive model profiles for operation of each discrete added energy source model under each different set of operating conditions.

15. A method for analyzing an electric power transmission and distribution network for assessing impacts and benefits of distributed energy resources (DER) for the electric power transmission and distribution network, to provide indication of the extent to which the transmission-level resources and distribution-level resources impact on each other, and of the merits of remedying deficiencies near their network locations, the method comprising:

simulating the electric power transmission and distribution network with a mathematical model as an Energynet in which transmission voltage-level elements and distribution voltage-level elements are integrated within the mathematical model; and

incorporating models of distributed energy resources at a plurality of network locations and voltage levels within the simulated network for analyzing resultant effects.

16. A method for assessing impacts and benefits of distributed energy resources (DER) for an electric power transmission and distribution network, the method comprising:

adding models for real energy sources, reactive energy sources, and combined real and reactive energy sources to modeled network locations in selected combinations; and

evaluating alternative combinations of the additions for their ability to improve selected characteristics of network stability, or voltage security, or reduction of real and reactive power losses, or deferral of conventional network modifications.

17. A method for assessing the potential impacts and benefits of distributed energy resources (DER) for an electric power transmission and distribution network, comprising:

adding to a network model a set of models of real and reactive energy sources for resultant improvement in network performance, independent of other considerations;

characterizing the set of added energy sources as a performance portfolio of individual projects for distributed energy resources, including dispatchable demand reduction, capacitive elements, and power generation; and

evaluating the economic value of improvements in network performance derived from proposed projects based on their similarity to the projects in the performance portfolio.

18. The method of claim 17, further comprising:

identifying the proposed projects that most closely resemble projects in the performance portfolio; and

selectively implementing the identified proposed projects for their beneficial economic or environmental impact and their beneficial performance improvement.

19. A computer readable medium comprising a computer program that when executed in a computer processor implements the steps of:

determining a model of the transmission-level buses and connected electrical elements, the model of the transmission-level buses including a plurality of transmission lines an a plurality of transmission electrical elements;

determining a model of the distribution-level buses and connected electrical elements, the model of the distribution-level buses including a plurality of distribution lines and a plurality of distribution electrical elements;

generating a single mathematical model by integrating the model of the transmission-level buses with the model of the distribution-level buses, wherein the single mathematical model further models the interdependency of the plurality of transmission lines and the plurality of transmission electrical elements included in the model of the transmission level buses and the plurality of distribution lines and the plurality of distribution electrical elements included in the model of the distribution-level buses;

integrating models of the distribution-level buses and connected electrical elements with models of the transmission-level buses and connected electrical elements into a single mathematical model;

simulating an operation of the electric power network with the single mathematical model;

calculating at least one of a condition and a performance of the simulated electric power network; and

outputting data describing at least one of a condition and a performance of the simulated electric power network.

20. The computer readable medium of claim 19, further comprising a computer program that when executed in a computer processor further implements the steps of:

integrating models of theoretical distribution-level sources of real and reactive energy sources connected to one or more of the plurality of distribution-level buses into the single mathematical model; and

calculating impacts and effects across the simulated electric power network of the theoretical distribution-level real and reactive energy sources connected on one or more the plurality of distribution-level buses.

Evidence Appendix

None.

Related Proceedings Appendix

None.